SYSTEM AND METHOD FOR TIMING REFERENCES FOR LINE INTERFACES

BACKGROUND

[0001] This invention relates to telecommunication systems and, more specifically, to generating timing signals for such systems.

[0002] In telecommunication networks or systems, data or a data stream is transported from one location in the network to another location in the network at various data rates. Typically, the data is transported between locations based on some synchronized or timed event. Thus, there is a need to have an accurate timing mechanism that is in phase with other timing sources in the system. Occasionally, the situation arises wherein the timing mechanism fails and the timing signal is lost temporality. Eventually, the timing signal is restored, however, when the timing device is restored, it is typically not synchronized or in phase with the other timing sources.

[0003] Known solutions include complex and expensive circuitry to ensure that a timing signal is not lost. Thus, in the event that the source of the timing signal is lost, circuitry acts as the timing source and generates a timing signal so that the system is not subject to phase problems due to lost and later restored timing signals. However, as indicated these solutions are costly and expensive. Additionally, such solutions typically are a temporary solution until the timing source for the timing signal can be restored.

[0004] Therefore, what is needed is a system and method for restoring and phase aligning two timing signals in the event that the source for one timing signal is lost temporarily and later restored or switched to another signal.

SUMMARY

[0005] A system and method are provided for restoring and phase aligning two timing signals when the source of one timing signal is temporarily lost and the lost timing signal is later restored. The system includes a selection unit coupled to a plurality of timing sources, wherein one time source is being

used as a reference and at least one of the timing sources is an internal timing source, a detection means coupled to the selection unit for detecting a failure in the reference timing source and causing the selection unit to switch to another timing source, and a unit coupled to the selection unit for comparing the phase of the other timing source to the phase of the output signal, wherein the unit introduces gradual phase alterations to the second timing signal until the first and second timing signals are in-phase.

[0006] The method includes switching to a timing source to provide the time signal when a failure is detected in an existing timing source, comparing the phase of the timing signal to the second timing signal to determine the phase of the timing signal relative to the phase of the second timing signal, and gradually phase shifting the second timing signal until the first timing signal and the second timing signal are in-phase.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Fig. 1 is a block diagram of system for phase aligning timing signals.

[0008] Fig. 2 is a time line representation for phase aligning timing signals for the system of Fig. 1.

[0009] Fig. 3 is a state diagram for the alarm events of the system of Fig. 1.

DETAILED DESCRIPTION

[0010] Referring now to FIG. 1, a system 10 includes a timing reference selector unit 12 coupled to a plurality of external timing sources 14 and an internal timing source 16. The connections shown are intended to show logical connections. In the event that all of the timing signals are lost, which includes at least the primary and secondary signal source 14, then the system 10 switches to use an internal signal generated by the internal timing source 16. The internal timing source 16 generates the 8 kHz reference signal by taking a 19.44 MHz signal and dividing by the value 2430 to get 8 kHz (8,000*2430=19,440,000). However, when a timing source fails and a replacement timing source is activate, the timing signal will be out of phase with respect to other timing

signals in the system 10, and hence, the timing signals will have to be phased aligned.

[0011] The selector unit 12 is coupled to a control unit 18, which provides input to the selector unit 12 to select another reference source to replace the failed timing source. The control unit 18 receives alarm conditions from an alarm activity unit 20. The control unit 18 provides input to the selector unit 12 based on the alarm conditions detected and reported by the activity unit 20 to the control unit 18. Accordingly, the selector unit 12 selects another timing source to generate the reference signal, which will be out of phase with the output signal once the reference signal is restored.

[0012] The alarm condition detected by the activity unit 20 is an indication of whether the current timing source is working properly or has failed. In the event that the alarm condition indicates that the current timing source has failed, then the alarm condition information that is passed to the control unit 18 is used by the control unit 18 to determine if the selector unit 12 needs to switch to another timing source.

[0013] The activity unit 20 also sends the alarm conditions to a unit 22. The unit 22 is coupled to a phase detection unit 24 and a Voltage Control Oscillator (VCO) 26. The detection unit 24 is coupled to a low-pass filter (LPF) unit 28, which is coupled to the VCO 26. Thus, the unit 22, detector unit 24, the LPF unit 28, and the VCO 26 form a feedback loop unit, which is discussed in detail below. The VCO 26 is also coupled to a generator unit 30. The unit 30 receives the output signal from the VCO 26 to generate and output a signal 34 at 19.44 MHz and a signal 36 at 8 kHz. The unit 30 is coupled to a metastability flip-flop (MSFF) unit 32, which is couple to and receives a reference signal from the selector unit 12. Using the reference signal, the MSFF unit 32 produces and outputs a signal to the unit 30. Additionally, the selector unit 12 is coupled to the MSFF unit 38 and the control unit 18 is coupled to the MSFF unit 40. Each of the MSFF units 38 and 40 output signals to the internal timing source unit 16.

[0014] The signal emerging from the VCO 26 is received from the detection unit 24 and is the signal that is used to generate the output signals 34 and 36. Thus, the phase of the reference signal sent from the selector unit 12 to the detection unit 24 must correspond to the phase of the output signals, such as the signal 36. More specifically, the reference signal of the system 10 must be synchronized with the output signal 36.

[0015] The signal received by the unit 22 from the VCO 26 is sent to the detection unit 24 for phase detection. The detection unit 24 compares the phase of the output signal received from the unit 22 to the phase of the reference signal received from the selector unit 12. Based on the relative phases of the two signals, the detection unit 24 in conjunction with the unit 22 either advance or retard the phase of the output signal until the phase of the output signal is aligned with the phase of the reference signal. The alteration in the phase of the output signal is done gradually to avoid any problems in the system 10, or the network, that are caused by sudden phase shifts or changes; this phase alteration is achieved over a number of cycles virtually undetected by the system 10.

[0016] Referring now to Fig. 1 and Fig. 2, Fig. 2 shows a time line 48 with a reference signal 52, which is outputted from the selection unit 12 to the detection unit 24, initially in-phase with a feedback signal 52 form the unit 22 to the detection unit 24 and an output signal 60. At a time 54 there is a loss of the timing source and, hence, the reference signal 50 is lost. Consequently, a lost signal alarm condition is created and the control unit 18 causes the selection unit 12 to switch to another reference source.

[0017] At a time 56 the feedback signal 52 is reset to produce a reset feedback signal 52' that is in-phase, at time 58, with a restored reference signal 50'. However, the signal 60 is now out-of-phase with the reference signal 50'. In order to phase shift the output signal, incremental and small phase shifts are gradually introduced, at a time 62 and 64, to the signal 60 to produce output signals 60' and 60" at times 62 and 64, respectively. The original signal 60 is

shown in broken line and the output signal 60" is in-phase at a time 66 with the reference signal 50'.

[0018] Referring now to Fig. 3, a state diagram is shown for the activity unit 20 working in conjunction with the control unit 18, wherein a "zero" represents no alarm condition and a "one" represents a triggered alarm. At state 100 the primary timing signal feed into the selector unit 12, Fig. 1, is used as long as the primary-alarm is zero. If the primary-alarm becomes one and a secondary-alarm is zero, then the system operates at state 102, where the secondary timing source is used. On the other hand, if the primary-alarm becomes one and the secondary-alarm is one, then the system goes to state 104.

[0019] With the system at state 102, if the secondary-alarm becomes one and the primary-alarm is back to zero, then the system operates at state 100 again.

[0020] On the other hand, while the system is at state 102 if both the secondary-alarm and the primary-alarm are one, then the system operates at state 104.

[0021] At state 104 the local or internal timing reference is used because the alarm conditions indicate that all external timing references are unavailable. In this example only two external timing references are shown; however, the scope of the invention as set forth herein is not limited thereby because there may be any number of external timing source, including only one source. If the secondary-alarm returns to zero while the system is at state 104 and the primary-alarm is one, then the system returns to operate at state 102, provided the revert-condition is zero. If the system is at state 104 and the primary-alarm becomes zero and the revert-condition is zero, then the system goes to state 100. Thus, the system can operate or use any timing source depending on the alarm conditions associated with those sources.

[0022] It is to be understood that the foregoing description is intended to illustrate and not limit the scope of the invention, which is defined by the scope of the appended claims. Other aspects, advantages, and modifications are

within the scope of the following claims. Although described in the context of particular embodiments, it will be apparent to those skilled in the art that a number of modifications to these teachings may occur. Thus, while the invention has been particularly shown and described with respect to one or more preferred embodiments thereof, it will be understood by those skilled in the art that certain modifications or changes, in form and shape, may be made therein without departing from the scope and spirit of the invention as set forth above and claimed hereafter.